Forest Cover Changes and Trajectories in an ancient Mining area of the Pyrenees from the Antiquity to the 19th c

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Ariège, France

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Context and Main Objectives

This study is a part of the interdisciplinary project **FODYNA** which is focused on an ancient mining area of the Pyrenees (fig. 1) located in the Province of Couserans. This area has differed from silver-lead and copper ore deposits, and from the traces of the road that have connected the Vicdessos to the "Port de Saleix" for centuries, which were used, since the 14th c., for the iron/charcoal exchange that was sealed with Vicdessos – a steel valley which sought to safeguard its wood resources.

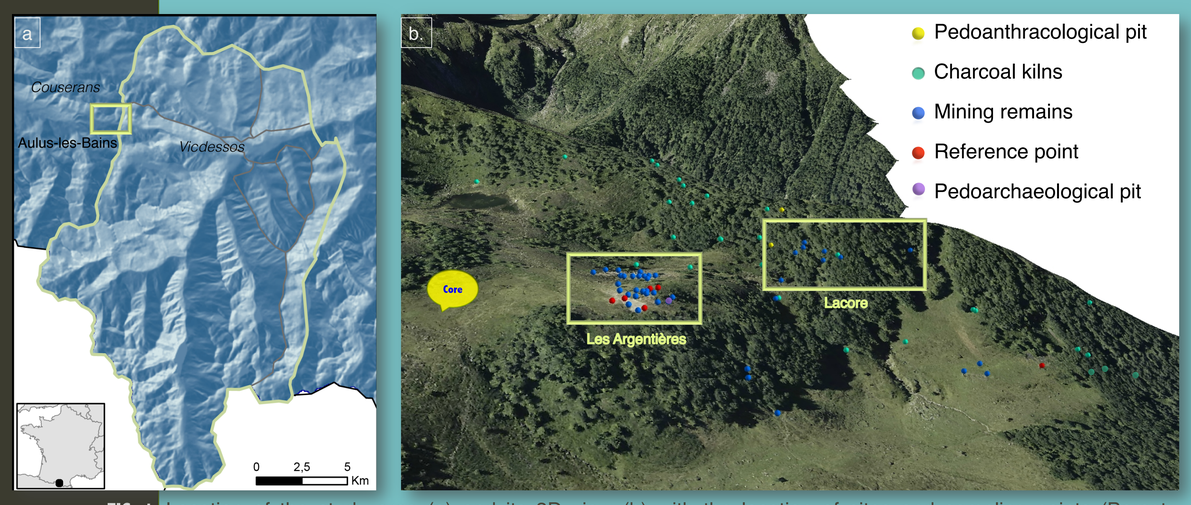

FIG. 1 Location of the study area (a) and its 3D view (b) with the location of sites and sampling points (Barcet, unpublished)

Its main objectives are:

- to characterise and to date the archaeological remains of mining and ore processing activities;
- to determine the geochemical imprint of lead ores that were exploited locally;
- to measure the impact of these activities on changes and trajectories of woodland cover;
- to understand the impact of charcoal burning and mining (firesetting) on soil charcoal concentration and anthracological assemblages.

A Multiproxy approach

The chronology of protoindustrial remains is based on a detailed archaeological survey (fig. 2, a) of which the data were included in a GIS, AMS ^{14}C, and textual data (Py *et al.*, 2014).

A pedo-archaeological pit was opened in a heap waste (fig. 2, c), associated with a trench affected by firesetting marks (fig. 2, b), for sampling galena fragments and residual charcoals (fig. 2, c).

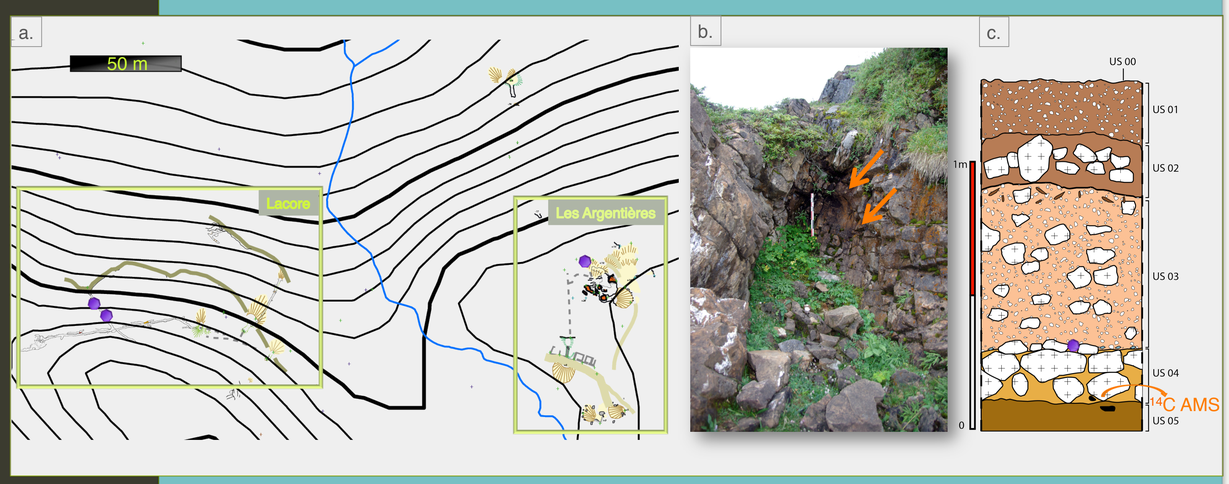

FIG. 2 (a) Map of both mining sectors with samples (●) location; (b) trenche with firesetting marks ↙; (c) stratigraphic cut of pedo-archaeological pit (Ancel, Py, Barcet, unpublished)

Other galena fragments were sampled in 18th c. Lacore works (fig. 2, a);

31 charcoal kilns (fig. 1, b) were sampled with a soil auger; charcoals were identified; growth rings were counted and their curvature (curved, intermediate, straight) and the felling season were evaluated;

2 pedo-anthracological pits were opened on the Lacore side (fig. 1, b).

Preliminary outcome & Interpretations

Chronology and imprints of local mining activities

Archaeological and ^{14}C data reveal that a first mining phase occured during the Roman period (151 cal BC-55 cal AD) in the "Les Argentières" sector. The ancient works were destroyed by two short attempts to exploit, in the 18th and the 19th c., affecting both sectors. Both mining phases and sectors are characterised by two clearly different isotopic imprints (fig. 3).

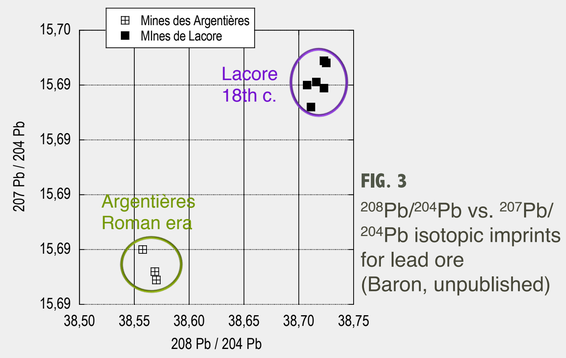

FIG. 3 ^{208}Pb/^{204}Pb vs. ^{207}Pb/^{204}Pb isotopic imprints for lead ore (Baron, unpublished)

Expansion of charcoal burning during the Renaissance and the Modern era

The charcoal kilns are staggered between 1400 and 1650 m. asl. (fig. 1, 5), in a wooded area (high-growing coppices of *Fagus sylvatica*) of approximately 50 ha., with low density (0,6 charcoal kiln / ha).

The ^{14}C AMS dates (only 10 as of now, fig. 4) suggest an expansion of charcoal burning during the 16th c. This period coincides with the functioning of the *mouline* of Castel-Minier into the valley below.

These data also suggest the intensification of the charcoal production in this area during the Modern era, i.e. when the iron metallurgy in the Vicdessos peaked. They probably demonstrate that the medieval treaty iron/charcoal exchange with the Vicdessos was still applicable.

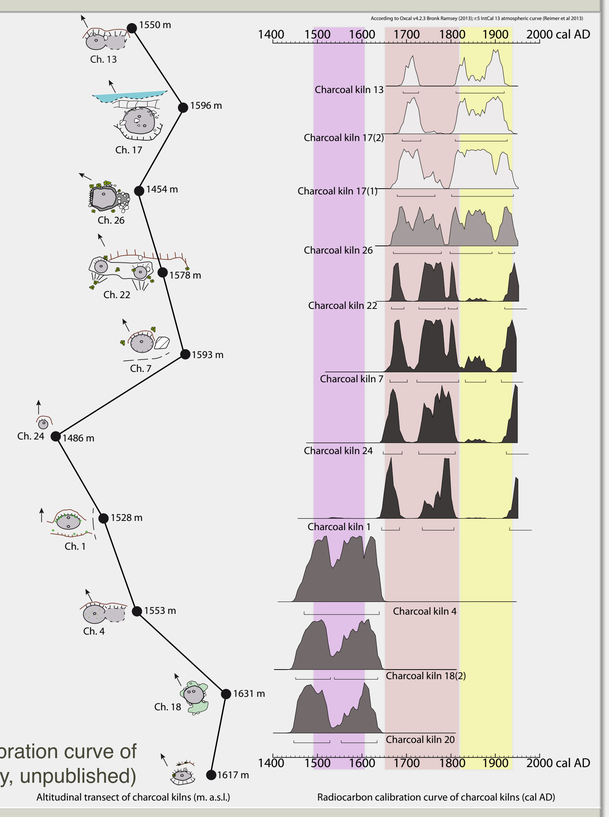

FIG. 4 Radiocarbon calibration curve of charcoal kilns and altitudinal transect (Py, unpublished)

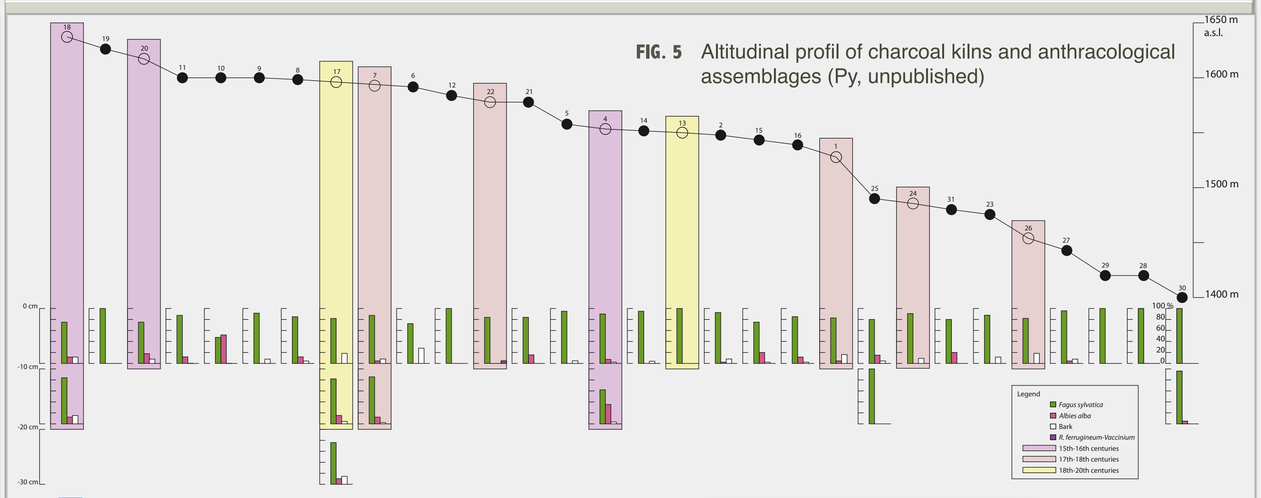

FIG. 5 Altitudinal profil of charcoal kilns and anthracological assemblages (Py, unpublished)

The issue of fir's extinction

The anthracological assemblages of charcoal kilns are dominated by beech associated with fir (fig. 5) for which the frequencies strongly decreased since the late Middle Ages (fig. 6). In the 16th c., charcoal burning contributed to the extinction of the fir but we must yet determine the roots of this change.

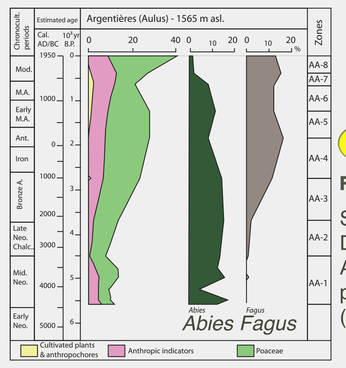

FIG. 6 Synthetic Diagram of the Argentières palynological record (Galop, 1998)

Outlooks

The combining of palynological, geochemical (comparison with atmospheric deposits sealed in lake and peat sediment), anthracological, dendro-anthracological and pedoanthracological data (ongoing for the most) should allow a detailed reconstruction of the woodland change between 1400-1700 m asl. and the impact of mining and ore processing activities in this high valley since the Antiquity.

REF: Galop, 1998. Galop, D., La forêt, l'homme et le troupeau das les Pyrénées. 6000 ans d'histoire de l'environnement entre Garonne et Méditerranée. Toulouse, GEODE.
Py *et al.*, 2014. Py, V., Ancel, B., Métaillé, J.-P., Baron, S., Cunill I Artigas, R., Prospection inventaire n°388. Commune d'Aulus-les-Bains (Ariège). Rapport de Prospection, Toulouse (ref. *in* ResearchGate).

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